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Testosterone Treatment and MMPI–2 Improvement in Transgender Men: A Prospective Controlled Study

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Objective: Most transgender men desire to receive testosterone treatment in order to masculinize their bodies. In this study, we aimed to investigate the short-term effects of testosterone treatment on psychological functioning in transgender men. This is the 1st controlled prospective follow-up study to examine such effects. ***Method:*** We examined a sample of transgender men ($n = 48$) and nontransgender male ($n = 53$) and female ($n = 62$) matched controls (mean age = 26.6 years; 74% White). We asked participants to complete the Minnesota Multiphasic Personality Inventory (2nd ed., or MMPI–2; Butcher, Graham, Tellegen, Dahlstrom, & Kaemmer, 2001) to assess psychological functioning at baseline and at the acute posttreatment follow-up (3 months after testosterone initiation). Regression models tested (a) Gender × Time interaction effects comparing divergent mean response profiles across measurements by gender identity; (b) changes in psychological functioning scores for acute postintervention measurements, adjusting for baseline measures, comparing transgender men with their matched nontransgender male and female controls and adjusting for baseline scores; and (c) changes in meeting clinical psychopathological thresholds. ***Results:*** Statistically significant changes in MMPI–2 scale scores were found at 3-month follow-up after initiating testosterone treatment relative to baseline for transgender men compared with female controls (female template): reductions in Hypochondria ($p < .05$), Depression ($p < .05$), Hysteria ($p < .05$), and Paranoia ($p < .01$); and increases in Masculinity–Femininity scores ($p < .01$). Gender × Time interaction effects were found for Hysteria ($p < .05$) and Paranoia ($p < .01$) relative to female controls (female template) and for Hypochondria ($p < .05$), Depression ($p < .01$), Hysteria ($p < .01$), Psychopathic Deviate ($p < .05$), Paranoia ($p < .01$), Psychasthenia ($p < .01$), and Schizophrenia ($p < .01$) compared with male controls (male template). In addition, the proportion of transgender men presenting with co-occurring psychopathology significantly decreased from baseline compared with 3-month follow-up relative to controls ($p < .05$). ***Conclusions:*** Findings suggest that testosterone treatment resulted in increased levels of psychological functioning on multiple domains in transgender men relative to nontransgender controls. These findings differed in comparisons of trans-

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gender men with female controls using the female template and with male controls using the male template. No iatrogenic effects of testosterone were found. These findings suggest a direct positive effect of 3 months of testosterone treatment on psychological functioning in transgender men.

Keywords: transgender, psychopathology, hormonal sex-reassignment therapy, female-to-male, testosterone

A transgender man is someone whose masculine gender identification is not aligned with the female sex he was assigned at birth. Compared with nontransgender individuals, transgender people experience multiple physical and mental health disparities including increased psychiatric comorbidity and higher rates of symptoms of anxiety, depression, and lifetime suicide attempts (Clements-Nolle, Marx, Guzman, Katz, & San Francisco Department of Public Health, 2001; Clements-Nolle, Marx, & Katz, 2006; Hepp, Kraemer, Schnyder, Miller, & Delsignore, 2005; Meier, Fitzgerald, Pardo, & Babcock, 2011) as well as systemic oppression; discrimination, social stigma; social, spiritual, and occupational rejection; physical and sexual violence; and harassment (Bockting, Miner, Swinburne, Hamilton, & Coleman, 2013; Budge, Adelson, & Howard, 2013; Effrig, Bieschke, & Locke, 2011; Hendricks & Testa, 2012; Meier & Labuski, 2013).

Because of these negative experiences, transgender people may hide their transgender identity from others or deny it to themselves for self-preservation. Minority stress theory (Bockting et al., 2013; Hendricks & Testa, 2012; I. H. Meyer, 2003) posits that transgender people experience stress related to "actual experiences of rejection and discrimination" as well as "perceived rejection and expectations of being stereotyped and discriminated against . . . and hiding minority status and identity for fear of harm (concealment)" (Bockting et al., 2013, p. 943). The act of concealing one's transgender status can lead to "hypervigilance and a preoccupation with hiding, which itself can become a significant source of stress" (Bockting et al., 2013, p. 943). Avoidant coping may have been learned early as many transgender people recall learning to hide their gender expression as early as childhood (Devor, 2004). Efforts to hide one's gender identity to protect oneself from harm are thought to create distress in and of themselves (Budge et al., 2013). Transgender people who are in the beginning of their gender transition may be more likely to experience more distress due to denial, hiding, and suppression of their transgender identity (Budge et al., 2012), and they may avoid social situations due to concerns about being judged by others for their appearance (Gómez-Gil et al., 2012), especially if they do not "pass" (i.e., are not perceived by others as their gender identity). Without taking the reasons behind these social patterns into account, transgender people may be assumed to be socially introverted or to have social deficits.

Many health providers have not been trained to initiate hormone treatment in transgender people (Obedin-Maliver et al., 2011) and may be reticent to do so especially when working with transgender men with lower psychological functioning. However, recent cross-sectional research suggests that testosterone treatment is associated with fewer symptoms of psychopathology in transgender men (Davis & Meier, 2014; Gómez-Gil et al., 2012; Meier et al. 2011; Newfield, Hart, Dibble, & Kohler, 2006); although no conclusive direct effects have been reported. Studies of hypogonadal males who were prescribed testosterone treatment have documented improved psychological functioning including improved mood, increased energy, and reduced depression (Dunning & Ward, 2004; Perry et al., 2002; Wang et al., 1996).

Transgender men may pursue testosterone treatment and surgical procedures to modify their primary and/or secondary sex characteristics to match their gender identity (Gómez-Gil et al. 2012), although not all transgender men opt to pursue medical treatment options. Testosterone for transgender men who desire to medically transition is a medically necessary treatment option that has been used in this capacity for more than 50 years (Coleman et al., 2011). Many transgender men who desire to pursue testosterone treatment as well as chest and/or genital surgery select testosterone only or as initial step in their transition because they are unable to access surgical treatment due the lack of insurance coverage in the United States (Bockting, Robinson, Benner, & Scheltema, 2004; Mikalson, Pardo, & Green, 2012) and the high costs of surgery (Meier & Labuski, 2013). Other transgender men may not pursue surgical treatments because they hope to preserve their reproductive capability or because the masculinizing effects of testosterone sufficiently address their body discomfort.

The physical effects of testosterone on transgender men are well documented. These include deepening of the voice; noticeable increase in hair growth on the face, pubic region, limbs, chest, back, and stomach; acne; changes in body odor; cessation of menstruation; enlargement of the clitoris; redistribution of fat; more coarse skin texture; increase in muscle mass; pelvic narrowing; and scalp hair loss if it is genetically inherited (Gooren & Giltay, 2008; Hembree et al., 2009; Moore, Wisniewski, & Dobs, 2003; Sitek, Fijalkowska, Żadzińska, & Antoszewski, 2012). The first changes that occur within 3 months are typically skin oiliness or acne, facial and body hair growth, body fat redistribution, cessation of menses, clitoral enlargement, and deepened voice (Gooren, 2005; Gooren, Giltay, & Bunck, 2008; Hembree et al., 2009).

Little is known, however, of the psychological effects of testosterone on transgender men. Several longitudinal studies on the effects of gender transitions focus more on physical and psychological genital surgical outcomes than on the prospective psychological effects of hormones (Cohen-Kettenis & Pfäfflin, 2003; Johansson, Sundbom, Höjerback, & Bodlund, 2010). In fact, much of the research on testosterone treatment among transgender men is cross-sectional (Davis & Meier, 2014; Dubois, 2012; Gómez-Gil et al., 2012; Meier et al., 2011; Newfield et al., 2006). The recent cross-sectional studies suggest that testosterone treatment among transgender men is associated with improved mental health and well-being, including increased quality of life (Meier et al., 2011; Newfield et al., 2006), decreased anxiety and depression (Davis & Meier, 2014; Gómez-Gil et al., 2012; Meier et al., 2011), decreased social distress (Gómez-Gil et al., 2012) and decreased

stress (Dubois, 2012; Meier et al., 2011). In addition, previous longitudinal studies of testosterone treatment among transgender men have examined its physical and cognitive effects, without examining psychosocial effects (W. J. Meyer, Walker, & Suplee, 1981; Slabbekoorn, van Goozen, Megens, Gooren, & Cohen-Kettenis, 1999; van Goozen, Slabbekoorn, Gooren, Sanders, & Cohen-Kettenis, 2002). A recent uncontrolled longitudinal study demonstrated fewer symptoms of anxiety and depression in a group of hormonally treated transgender men and women over 1 year (Colizzi, Costa, & Todarello, 2014). To our knowledge, no published controlled study has prospectively examined the effects of testosterone on the psychological functioning of transgender men compared with matched female and male controls.

The Minnesota Multiphasic Personality Inventory(2nd ed.; MMPI–2; Butcher, Dahlstrom, Graham, Tellegen, & Kaemmer, 1989; Butcher, Graham, Tellegen, Dahlstrom, & Kaemmer, 2001) is one of the oldest and most widely used psychological assessment tools (Weiner & Greene, 2006). Although it was originally designed to establish psychological diagnoses, the test provides a broader picture of a person's behaviors and symptoms of psychopathology (Weiner & Greene 2006). MMPI–2 profiles are used to assess long-term stability of personality and psychopathology (Butcher et al., 2001). Generally, MMPI–2 results remain stable over time; even in individuals who have had intensive psychotherapy, MMPI–2 profiles typically do not show significant improvement until after a few years (Spiro, Butcher, Levenson, Aldwin, & Bossé, 2000). Only intensive treatments, such as electroconvulsive therapy combined with psychotherapy, tend to alter MMPI–2 profiles in a short time period (4 months; Spiro et al., 2000). Prospective administration of the MMPI–2 should not reveal significantly different results over a 3-month assessment period in an untreated sample.

Previous cross-sectional studies have examined MMPI personality profiles of transgender people with the intent of determining if they were experiencing severe psychopathology (Gómez-Gil, Vidal-Hagemeijer, & Salamero, 2008; Leavitt, Berger, Hoeppner, & Northrop, 1980; Miach, Berah, Butcher, & Rouse, 2000; Tsushima & Wedding, 1979). Existing MMPI studies examining transgender men found elevations on the Psychopathic Deviate scale and the Masculinity–Femininity scale (Roback, McKee, Webb, Abramowitz, & Abramowitz 1976; Rosen, 1974). Roback et al. (1976) explained the elevation on the Psychopathic Deviate scale was likely related to the social difficulties that the transgender men experience due to their variation from expected sex-role conventions. The elevation on the Masculinity–Femininity scale was anticipated and indicated that transgender men reported more masculine traits than would be expected of females. A cross-sectional study comparing MMPI profiles of pre- and postsurgical transgender men found mean scale elevations on the Masculinity–Femininity and the Hypomania scale in presurgical transgender men, while postsurgical transgender men demonstrated much lower scores on the Paranoia scale, the Schizophrenia scale, and the Hypomania scale than presurgical transgender men (Fleming, Cohen, Salt, Jones, & Jenkins 1981). One recent cross-sectional study did not find significant differences in MMPI–2 clinical scales between pre- and post-hormone-treated transgender men who had been treated for at least 12 months (Gómez-Gil et al., 2008). Moreover, mean scores of both groups were found to be in the normative range.

The World Professional Association for Transgender Health's Standards of Care (Coleman et al., 2011) has urged mental and medical health practitioners to be familiar with the effects of hormone treatment. A meta-analysis of research on the quality of life and psychosocial outcomes of hormone treatment on transgender people reported that the evidence reviewed was of "very low quality" due to observational methods, lack of control groups, and cross-sectional designs (Murad et al., 2010). Recent research has called for more rigorous longitudinal research studies examining quality of life and psychosocial outcomes of hormone treatment (Gómez-Gil et al., 2012; Meier et al., 2011; Murad et al., 2010).

The current study examined the impact of testosterone treatment on psychological functioning of transgender men in a controlled longitudinal study. The aim of the present study was to investigate the psychopathology profiles of a community sample of transgender men within about 1 month of initiating testosterone treatment (baseline) and matched healthy nontransgender male and female controls and to compare these profiles with ones assessed 3 months later. Transgender men were matched to male and female controls at baseline on the variables of age and education level. Based on a review of previous cross-sectional findings, we hypothesized that transgender men's psychological profiles would show higher levels of psychopathology on the Psychopathic Deviate, Masculinity–Femininity, Paranoia, Schizophrenia, and Social Introversion scales relative to controls at baseline. Further, we hypothesized that while controls' profiles would remain stable, transgender men's profiles would demonstrate increases in psychological functioning on all scales except the Masculinity–Femininity scale after 3 months of testosterone treatment. To our knowledge, this is the first study to investigate the effects of testosterone on psychological functioning in transgender men using a controlled longitudinal design.

Method

Sample

Two hundred seventy-four participants were recruited to participate in a year-long longitudinal study on the psychological effects of testosterone on psychopathology, cognitive functioning, sexuality, and psychosocial well-being. A total of 233 participants consented to participate and completed the baseline assessment. The present study focused on the 163 participants who completed the MMPI–2 at the baseline assessment (Time 1) and 3-month follow-up (Time 2; retention rate = 70.0%) and who had valid MMPI–2 scores (one participant did not contribute data to analyses due to a high score on the Lie validity scale (T score $>$ 80; (de Vries, Kreukels, Steensma, Doreleijers, & Cohen-Kettenis, 2011). Purposive sampling was used to recruit participants through the University of Houston subject pool, Houston community, personal contacts, transgender conferences, advertisements on transgender men-specific online groups and blogs, and transgender men's support groups in the United States. All study procedures were approved by the institutional review board at the University of Houston. The current study is part of a larger, ongoing, year-long study on the psychological effects of testosterone on psychopathology, cognitive functioning, sexuality, and psychosocial well-being. Participants were informed of the purpose of the study but were not informed of the specific hypotheses being tested. Written

informed consent was provided by all participants and, in one case, from a parent of a 16-year-old transgender participant. Participants were paid $10 in the form of a gift card for completing each assessment.

Transgender men who were recruited to be included in the study were planning to initiate testosterone treatment within 6 months of the first assessment visit. On average, participants began testosterone 21 days after completing the initial assessment. Just over one third ($n = 17$) of participants had initiated testosterone treatment immediately prior to completing the initial assessment ($M = 17$ days, $SD = 11.5$ days; range 1–38 days). Testosterone treatment in the majority of transgender participants consisted of intramuscular (IM) injections ($n = 46$; depo-testosterone cypionate or ethanate). Guidelines set forth by the Endocrine Society suggest transgender men inject 100–200 mg/14 days or 50% weekly (Hembree et al., 2009). It has been recommended that testosterone levels be monitored by laboratory testing on a regular basis (Coleman et al., 2011). Based on test results, the dose and method of administration may be changed by a medical provider (Coleman et al., 2011). Rarely, a higher dose may be indicated if a transgender man's testosterone levels remain in the low normal range after 200 mg every 2 weeks (University of California, San Francisco, Department of Family and Community Medicine, Center of Excellence for Transgender Health, 2011). Most participants' ($n = 32$) IM dosages ranged from 50 to 400 mg every 10–14 days or 50% weekly. One participant was taking 200 mg every 3 weeks. Several participants ($n = 7$) were started out at one dose (range: 25–100 mg weekly) and their doctors increased their dose (range: 50–200 mg weekly). Two participants' dosages were decreased from 75 to 50 mg/week and from 200 to 150 mg/14 days. Daily transdermal testosterone gel ($n = 1$) or patches ($n = 1$) were used by a few participants. Two participants started out using IM and then changed methods of administration within the first 3 months of treatment (IM and then patch; IM followed by cream and then IM).

Controls were required to be older than 18 years and not identify as transgender. Male and female controls must have reported a history of going through puberty and no history of hypogonadism or hormone imbalance. As a control for fluctuating hormone levels, females completed the protocol during their menstrual cycle at each assessment. One female control was excluded as she became pregnant during the study.

Transgender men who intended to begin testosterone therapy and maintain hormone treatment for a minimum of 1 year were recruited. Transgender men who had begun testosterone treatment within the previous month were included in the protocol, as masculinizing effects generally do not take place until 3 or more months after initiating testosterone treatment (Gooren, 2005; Gooren, Giltay, & Bunck, 2008; Hembree et al., 2009).

Procedure

As part of a larger ongoing study, three groups of participants (transgender men and nontransgender males and females) completed a variety of written demographic and psychological measures at three time points over a 1-year period. Participants were individually administered the MMPI–2 to assess psychological functioning. The current study examined participants' MMPI–2 profiles at baseline (Time 1) and 3 months later (Time 2).

Measures

Personality profiles were evaluated using the Minnesota Multiphasic Personality Inventory (2nd ed.; MMPI-2; Butcher et al., 2001). The MMPI–2 is the most commonly utilized assessment of psychopathology (Gómez-Gil et al., 2008). Reliability and validity of this instrument have been well established (Butcher et al., 2001). The MMPI-2 has good reliability, with both test–retest and internal consistency correlations mostly between 0.70 and 0.90 (Butcher et al., 2001). The MMPI–2 utilizes 567 true/false items in order to assess a range of personality profiles. It is estimated to take 60–90 min to complete. The second version of the MMPI is a restandardized version of the original MMPI and contains three validity scales (Lie, Infrequency, and Correction) in order to ensure that the profile is valid. It also contains 10 clinical scales: Hypochondriasis (1), Depression (2), Hysteria (3), Psychopathic-Deviate (4), Masculinity–Femininity (5), Paranoia (6), Psychasthenia (7), Schizophrenia (8), Hypomania (9), and Social Introversion (0). Raw scores are converted to *T* scores and compared with normative data for assigned sex. The higher the mean scores, the lower the level of psychological functioning. *T* scores above 65 (1.5 *SDs* above the mean) are considered to be clinically significant (Butcher et al. 2001).

In previous research, the female template has been used for scoring profiles of transgender men on the MMPI–2 (Fleming et al., 1981; Gómez-Gil et al., 2008; Roback et al., 1976; Rosen, 1974). However, which sex template to score transgender men on in MMPI–2 research represents a methodological question, given that sex-normed templates do not consider sex and gender to be different constructs. The templates' standardization is based on a national sample of over 2,000 adults. Sex and gender were not queried separately in this standardization research to cross-classify respondents and identify transgender adults. We therefore scored transgender men on the female template when comparing them with female controls and on the male template when comparing them with male controls. This strategy was implemented in order to consider and be responsive to both sex-linked and gender-linked mechanisms of psychopathology (Krieger, 2003).

Data Analysis

SAS (Version 9.3) statistical software was used for all data analyses. Statistical significance was determined at the alpha 0.05 level, and two-tailed tests of significance were conducted. Descriptive statistics were obtained for all variables (frequencies, means, standard deviations). Transgender men who had initiated testosterone treatment prior to baseline (33.3%) were compared with transgender men who had not started testosterone at treatment at baseline. There were no statistically significant differences by testosterone use in baseline mean scores in any of the MMPI–2 scales, using either the female or the male template (analyses not tabled). Analyses therefore compared all transgender men to female and male controls, respectively, focusing on (a) MMPI–2 scale scores (continuous) and (b) MMPI–2 clinical elevations (meeting a clinically elevated binary threshold for each MMPI–2 scale, T score > 65).

Bivariate comparisons. Bivariate differences in MMPI–2 scale scores and in clinical elevations by gender identity (transgender men vs. female controls on the female template and transgender men vs male controls on the male template) were estimated

separately for baseline (Time 1) and 3-month follow-up (Time 2) assessments. No direct comparisons were made between male and female nontransgender controls because the study design matched controls to the demographic distribution of the transgender men and adding comparisons between the male and female controls would require additional pairwise comparisons, which would inflate Type I error. Assuming independence at each time point, unadjusted linear (scale scores) and logistic (clinical cut points) regression models were used to compare transgender men with male and female controls.

Analyses of change. Because a longitudinal, repeated-measures design was used to collect identical measures on the same individuals on two measurements, assessments were positively correlated. Appropriate statistical procedures were utilized to adjust standard errors for within-person autocorrelation across time when modeling change (Fitzmaurice, Laird, & Ware, 2004; Singer & Willett, 2003). First, each of the MMPI–2 scale scores were modeled using longitudinal linear regression models as separate outcomes (two observations per individual participant; 326 total observations) to analyze the mean response profiles of participants by transgender identity over time adjusting for matching. The aim of this analysis was to characterize the patterns of change in the mean response over time and to determine if the shapes of the mean response profiles differed for transgender men compared with female and male controls, scored on the female and male template, respectively. The null hypothesis tested was that the mean response profiles of transgender men and controls were parallel (e.g., no Group × Time interactions). To test this hypothesis, a Transgender Men × Time interaction term was for each longitudinal model with MMPI–2 scale score as an outcome. Next, each of the MMPI–2 scales (*T* scores) at Time 2 were modeled using an analysis of covariance (ANCOVA) approach to estimate whether there was a difference in means by gender identity, adjusting for baseline Time 1 MMPI–2 scores (i.e., adjusted change scores; Fitzmaurice et al. 2004). Linear models regressed each Time 2 MMPI–2 score on gender identity, adjusting for Time 1 MMPI–2 scores and appropriately accounting for matching. Transgender men were compared with male and with female controls, respectively.

Each MMPI–2 scale score was also categorized as either meeting a clinically significant threshold (*T* score $>$ 65) or not (*T* score $\leq$ 65; de Vries et al., 2011). Changes in clinical elevations for each MMPI–2 scale are descriptively presented but were not empirically tested due to small cell sizes. Instead, three binary outcomes were constructed using each of the dichotomized elevated scales to obtain an adequate number of cases to statistically compare changes in clinical diagnoses at Time 1 and Time 2: (a) any clinical elevation, (b) two or more clinical elevations, and (c) three or more clinical elevations. As in previous research the Masculinity–Femininity scale was excluded from this calculation (see de Vries et al., 2011). The McNemar's test, a two-sample test for binomial proportions appropriate for matched-pair data (Rosner, 2006), is equivalent to the paired *t* test and appropriate for use with binary outcomes, so it was used to examine changes in the proportion of clinical diagnoses over time for transgender men and male and female controls, each separately.

Attrition. An analysis of attrition was conducted comparing baseline demographic and MMPI–2 variables for those who were lost to follow-up relative to those who were not using *t* tests. No statistically significant differences were found by gender identity, age, race/ethnicity, or education comparing noncompleters and completers. There was a significant difference in MMPI–2 Hypomania scores at Time 1 for noncompleters ($M = 58.4$; $SD = 12.9$) compared with completers ($M = 53.8$; $SD = 11.1$), $t(225) = -2.51$, $p = .014$. Noncompleters also had elevated MMPI–2 baseline frequency scale (F) scores ($M = 62.0$; $SD = 15.3$) compared with completers ($M = 57.4$; $SD = 14.5$), $t(225) = -2.04$, $p = .044$. No other baseline differences in MMPI–2 scale scores or validity scores were found for participants lost to follow-up relative to those who completed both Time 1 and Time 2 assessments.

Results

Participants

Participant's ages ranged from 16 to 54 ($M = 26.6$; $SD = 8.4$). The breakdown of race/ethnicity was 74.2% White ($n = 121$), 15.9% Latino/Hispanic/Chicano ($n = 26$), 11.0% Asian/Asian American ($n = 18$), 3.7% Black/African American ($n = 6$), 1.8% Pacific Islander ($n = 3$), 1.2% Middle Eastern ($n = 2$), 0.6% Native American ($n = 1$), and 2.5% other ($n = 4$). For education, participants indicated the following: 13.5% high school diploma or less, 44.8% some college, 29.4% college degree, and 12.3% graduate degree.

Table 1 presents demographic data for age and education by gender identity (matching factors), including bivariate comparisons. As expected, given the matched controlled design of this study, no significant differences in age and education were noted between transgender men and male and female controls.

Descriptive Characteristics of Psychological Functioning at Time 1 and Time 2

Table 2 descriptively presents MMPI–2 scale scores and clinical elevations, including bivariate comparisons by gender identity separately for Time 1 and Time 2 assessments.

At baseline, two of 10 MMPI–2 mean scale scores (Masculinity–Femininity and Social Introversion) were significantly higher ($p < .05$) for transgender men compared with females (Table 3); no other significant baseline differences were found for transgender men relative to female controls. At 3-month follow up, while Masculinity–Femininity mean scale scores remained significantly higher for transgender men relative to females, significant differences were no longer found on Social Introversion. Further, transgender men demonstrated statistically significantly lower mean scores on Depression and Psychasthenia than female controls.

At baseline, nine of 10 MMPI–2 mean scale scores (exception: Hypomania) were significantly higher for transgender men compared with male controls (Table 3). At 3-month follow-up, only four of 10 MMPI–2 mean scale scores (Depression, Masculinity–Femininity, Schizophrenia, and Social Introversion) remained significantly higher for transgender men relative to male controls. There were no longer statistically significant differences between transgender men and male controls on Hypochondria, Hysteria, Psychopathic Deviate, Paranoia, or Psychasthenia scale after 3 months of testosterone administration.

Table 1
Sociodemographic Characteristics by Gender Identity

Characteristic	Transgender men (n = 48)			Female (n = 62)			Male (n = 53)			Bivariate comparisons			Total (n = 163)		
	M (*SD*)	%	*n*	*M* (*SD*)	%	*n*	*M* (*SD*)	%	*n*	$F(2, 159)$	$\chi^2(2)$	*p*	*M* (*SD*)	%	*n*
Age in years										0.39		.68	26.6 (8.4)		
Mean (*SD*)	27.0 (8.9)			27.1 (8.9)			25.8 (7.5)								
Range	16–51			18–54			18–50						18–54		
Educational attainment															
High school diploma or less		20.8	10		11.3	7		9.4	5		3.10	.21		13.5	22
Some college/associate's degree		43.8	21		46.8	29		43.4	23		0.16	.92		44.8	73
College degree		29.2	14		27.4	17		32.1	17		1.43	.49		29.4	48
Graduate degree		6.2	3		14.5	9		15.1	8		2.16	.34		12.3	20
Employment status[a]															
Student		41.7	20		35.5	22		30.2	16		1.29	.53		35.6	58
Unemployed		12.5	6		6.5	4		5.7	3		1.80	.41		8.0	13
Full-time work		35.4	17		32.3	20		45.3	24		2.45	.29		37.4	61
Part-time work		27.1	13		35.5	22		18.9	10		3.66	.16		27.6	45

Note. To examine sociodemographic differences by gender identity, we fit unadjusted regression models with gender identity (male and female each compared with transgender men) as the predictor. Linear models were fit for age and logistic models for educational attainment, employment status, and ethnicity.
[a] Employment status sums to >100% given participants could indicate all that applied.

At baseline, a significantly higher proportion of transgender men compared with male controls (male template) met clinical thresholds for eight of 10 scales (Hypochondria, Depression, Hysteria, Masculinity–Femininity, Paranoia, Psychasthenia, Schizophrenia, and Social Introversion). At follow-up, the disproportionate number of clinical elevations was reduced to two of 10 clinical elevations compared with male controls (Schizophrenia and Social Introversion). Compared with female controls (female template), a higher proportion of transgender men met clinical thresholds for Masculinity–Femininity at both baseline and follow-up. At follow-up, the proportion of transgender men meeting clinical threshold for Paranoia (2.1%) was significantly lower than among the female controls (17.7%).

Mean Response Profile Differences for Transgender Men Versus Female and Male Controls: Transgender × Time Interaction Effects

A Transgender × Time interaction term was fit in longitudinal linear models to examine whether mean response profiles on each MMPI–2 scale score were similar or different for transgender men compared with female and male controls on their respective sex-specific templates (Table 3). Statistically significant interactions were found for two of 10 scales (Hysteria and Paranoia) compared with female controls and for seven of 10 scales (Hypochondria, Depression, Hysteria, Psychopathic Deviate, Paranoia, Psychasthenia, and Schizophrenia) compared with male controls.

Interaction effects are graphically depicted in Figure 1. Shown are Hysteria and Paranoia for transgender compared with female controls, and Depression and Psychasthenia for transgender men versus male controls (examples of Transgender Men × Time interactions compared with male controls). Transgender men showed steeper increases in functioning, and sometimes in reverse directions as controls.

Changes in MMPI–2 Scores at Acute Postbaseline 3-Month Follow-Up, Adjusting for Baseline MMPI–2 Scores

As shown in Table 3, the ANCOVAs, regressing Time 2 scores on gender identity and adjusting for Time 1 scores, demonstrated statistically significant differences in MMPI–2 scores at 3-month follow-up relative to baseline for transgender men compared separately with female and male controls on female and male templates, respectively. Transgender men relative to female controls also showed significant reductions (main effects) in Hypochondria, Depression, Hysteria, and Paranoia, as well as significantly increased Masculinity–Femininity scores with adjustment for baseline MMPI–2 scores. No statistically significant main effect differences were found comparing transgender men and male controls after accounting for baseline MMPI–2 scores. In all models, the global *F* test suggests that MMPI–2 scores at Time 1 significantly predicted MMPI–2 scores at Time 2.

Changes in the Proportion of Cases Meeting MMPI–2 Clinical Elevations

MMPI–2 Masculinity–Femininity scale (Scale 5) was excluded from summary count of clinical elevations. At baseline, transgender men's MMPI–2 profiles were significantly more likely to meet any clinical elevation (72.9% vs. 41.5%), two or more clinical elevations (45.8% vs. 18.9%), and three or more elevations (33.3% vs. 5.7%) at baseline on the male template compared with male controls (Table 4). Similar differences were not found comparing transgender men and female controls on the female template at baseline.

The proportion of transgender men showing elevations for clinical scales decreased significantly from baseline to follow-up on both the female (Test Statistic A) and male (Test Statistic C) templates (Table 4). There were no statistically significant reduc-

Table 2
Descriptive Characteristics and Bivariate Comparisons of Psychological Functioning at Baseline (Time 1) and Acute Postbaseline 3-Month Follow-Up (Time 2) by Gender Identity (N = 163)

	MMPI–2 scores: Mean (*SD*)				MMPI–2 clinical elevations ($T > 65$, yes/no): % (*n*)			
	Female template		Male template		Female template		Male template	
Variable	Transgender men	Female	Transgender men	Male	Transgender men	Female	Transgender men	Male
Scale 1: Hypochondria								
Time 1	53.7 (10.1)	54.0 (11.1)	**56.2 (10.7)**	**49.7 (8.2)****	14.6 (7)	19.4 (12)	**16.7 (8)**	**1.9 (1)***
Time 2	49.5 (9.6)	52.8 (9.4)†	51.9 (9.9)	49.3 (9.1)	8.3 (4)	12.9 (8)	8.3 (4)	3.8 (2)
Scale 2: Depression								
Time 1	53.9 (10.1)	56.3 (14.3)	**58.4 (10.5)**	**48.2 (9.6)*****	12.5 (6)	25.8 (16)†	**20.8 (10)**	**3.8 (2)***
Time 2	**49.8 (9.9)**	**54.8 (13.1)***	**53.6 (10.7)**	**48.9 (9.6)***	8.3 (4)	19.4 (12)	10.4 (5)	3.3 (2)
Scale 3: Hysteria								
Time 1	51.3 (9.8)	51.7 (10.3)	**54.0 (10.3)**	**49.2 (9.1)***	6.3 (3)	11.3 (7)	**16.7 (8)**	**1.9 (1)***
Time 2	47.2 (9.1)	51.1 (11.1)†	49.5 (9.5)	49.3 (9.3)	2.1 (1)	11.3 (7)	2.1 (1)	5.7 (3)
Scale 4: Psychopathic Deviate								
Time 1	60.3 (11.7)	57.5 (11.3)	**59.0 (11.6)**	**52.6 (11.2)****	35.4 (17)	29.0 (18)	25.0 (12)	11.3 (6)†
Time 2	55.2 (9.8)	55.5 (11.4)	53.9 (9.6)	50.9 (10.5)	14.6 (7)	17.7 (11)	10.4 (5)	13.2 (7)
Scale 5: Masculinity/Femininity								
Time 1	**62.9 (12.2)**	**57.8 (9.7)***	**58.3 (10.5)**	**48.7 (10.3)*****	**52.1 (25)**	**16.1 (10)***	**25.0 (12)**	**5.7 (3)***
Time 2	**65.1 (13.0)**	**56.8 (10.8)****	**57.1 (10.8)**	**48.2 (12.7)****	**58.3 (28)**	**17.7 (11)****	18.8 (9)	11.3 (6)
Scale 6: Paranoia								
Time 1	56.0 (11.4)	53.9 (12.9)	**56.9 (11.7)**	**48.0 (11.1)****	25.0 (12)	16.1 (10)	**25.0 (12)**	**5.7 (3)***
Time 2	49.9 (9.0)	53.2 (11.7)	50.9 (9.4)	48.0 (9.9)	**2.1 (1)**	**17.7 (11)***	2.1 (1)	3.8 (2)
Scale 7: Psychasthenia								
Time 1	55.2 (11.8)	58.5 (12.4)	**57.7 (13.0)**	**50.0 (9.1)****	22.9 (11)	25.8 (16)	**25.0 (12)**	**7.7 (4)***
Time 2	**51.2 (10.4)**	**56.7 (12.9)***	53.8 (11.1)	51.0 (10.2)	8.3 (4)	22.6 (14)†	12.5 (6)	5.7 (3)
Scale 8: Schizophrenia								
Time 1	62.2 (12.5)	60.5 (13.5)	**62.5 (13.5)**	**51.9 (10.1)*****	43.8 (21)	35.5 (22)	**43.8 (21)**	**9.4 (5)****
Time 2	57.9 (11.8)	57.3 (11.8)	**58.5 (13.1)**	**53.2 (8.8)***	35.4 (17)	29.0 (18)	**35.4 (17)**	**7.6 (4)****
Scale 9: Hypomania								
Time 1	53.5 (12.2)	54.2 (10.9)	50.9 (12.5)	53.8 (10.6)	20.8 (10)	17.7 (11)	14.6 (7)	17.0 (9)
Time 2	53.0 (10.9)	52.8 (10.8)	50.7 (10.6)	54.5 (12.5)	18.8 (9)	12.9 (8)	16.7 (8)	22.6 (12)
Scale 10: Social Introversion								
Time 1	**54.1 (11.7)**	**49.6 (11.4)***	**56.4 (12.4)**	**47.2 (11.1)****	16.7 (8)	9.7 (6)	**27.1 (13)**	**9.4 (5)***
Time 2	53.8 (10.8)	50.1 (10.7)†	**56.5 (11.7)**	**48.2 (11.7)****	16.7 (8)	9.7 (6)	**27.1 (13)**	**11.3 (6)***

Note. Transgender men: $n = 48$, females: $n = 62$, and males: $n = 53$. Bold typeface indicates statistical significance. Bivariate, unadjusted regression models (linear models for Minnesota Multiphasic Personality Inventory [2nd ed.; MMPI–2] scores and logistic models for MMPI–2 diagnoses) were fit to compare transgender men with female controls (scored on the female template) and with male controls (scored on the male template). This was done for Time 1 and Time 2 separately (i.e., treating each time point as independent) to examine differences in MMPI–2 by transgender identity at each time point.
† $p < .10$. * $p < .05$. ** $p < .01$. *** $p < .001$.

tions in the proportion of female (Test Statistic B) and male (Test Statistic D) controls meeting these clinical cut points from baseline to Time 2, suggesting the relative stability of MMPI–2 clinical elevations for matched controls.

Discussion

This is the first known study in the United States to prospectively investigate the effects of testosterone on psychological functioning in transgender men using a controlled longitudinal design. This study aimed to investigate changes in psychopathology profiles of a community sample of transgender men as they are beginning hormone therapy and 3 months later compared with a community sample of matched, nontransgender male and female healthy controls.

First, relative to both male and female controls, psychological functioning of transgender men significantly improved prospectively after only 3 months of testosterone therapy. Transgender men's MMPI–2 profiles demonstrated significantly fewer clinical elevations at the 3-month follow-up assessment compared with baseline. For example, the number of transgender men who demonstrated two or more clinical elevations at baseline decreased from 43% to 25% (female template) and from 46% to 27% (male template) 3 months after initiating testosterone. This finding provides support to the idea that hormone treatment is a medically necessary intervention for transgender individuals. The Masculinity–Femininity scale was the only scale that remained significantly elevated among transgender men compared with both male and female control groups.

The Masculinity–Femininity scale was originally intended to measure 1940's stereotypical male and female vocational interests (Hathaway, 1956; Hathaway & McKinley, 1943). However, much of the early research on this scale attempted to use it to identify gay men, and although currently most clinicians do not interpret elevations on the Masculinity–Femininity scale, some may interpret

Table 3
Longitudinal Linear Models of Mean Response Profiles Over Time and Analysis of Covariance (ANCOVA) Modeling Changes in MMPI–2 Scores From Baseline (Time 1) to Acute Postbaseline 3-Month Follow-Up (Time 2) With Adjustment for Baseline MMPI–2 Scores (N = 163)

	Female controls				
	Change scores (female template) ΔT2 − T1		(A) Longitudinal models: Transgender Men × Time interaction β (95% CL)	(B) ANCOVA *F*(2, 107) β (95% CL)	
Variable	Transgender men	Female		Transgender men vs. female	MMPI–2 scores Time 1
Scale 1: Hypochondria	−4.2 (9.1)	−1.1 (8.7)	−3.02 [−6.40, 0.36]	**−3.14*** **[−6.00, −0.29]**	**0.55***** **[0.42, 0.68]**
Scale 2: Depression	−4.1 (7.2)	−1.4 (8.1)	−2.68† [−5.62, 0.25]	**−3.28*** **[−5.99, −0.58]**	**0.75***** **[0.65, 0.86]**
Scale 3: Hysteria	−4.2 (7.9)	−0.6 (9.4)	**−3.52*** **[−6.86, −0.18]**	**−3.66*** **[−6.72, −0.61]**	**0.64***** **[0.49, 0.79]**
Scale 4: Psychopathic Deviate	−5.1 (8.5)	−2.0 (8.8)	−3.19† [−6.51, 0.12]	−2.19 [−5.16, 0.78]	**0.65***** **[0.52, 0.78]**
Scale 5: MF	2.2 (11.3)	−1.0 (9.4)	3.21 [−0.70, 7.13]	**5.05**** **[1.31, 8.78]**	**0.64***** **[0.47, 0.81]**
Scale 6: Paranoia	−6.1 (8.9)	−0.7 (8.6)	**−5.41**** **[−8.45, −2.06]**	**−4.62**** **[−7.47, −1.77]**	**0.62***** **[0.50, 0.73]**
Scale 7: Psychasthenia	−4.0 (8.6)	−1.8 (9.7)	−2.18 [−5.70, 1.34]	−3.20† [−6.46, 0.05]	**0.69***** **[0.56, 0.82]**
Scale 8: Schizophrenia	−4.3 (8.5)	−3.2 (7.6)	−1.08 [−4.12, 1.97]	−0.59 [−3.31, 2.14]	**0.72***** **[0.62, 0.82]**
Scale 9: Hypomania	−0.5 (8.0)	−1.4 (8.8)	0.92 [−2.31, 4.16]	0.70 [−2.21, 3.62]	**0.67***** **[0.55, 0.80]**
Scale 0: Social Inversion	−0.3 (5.1)	0.5 (5.6)	−0.78 [−2.84, 1.28]	−0.03 [−1.96, 1.95]	**0.83***** **[0.74, 0.91]**

	Male controls				
	Change scores (male template) ΔT2 − T1		(C) Longitudinal models: Transgender Men × Time interaction β (95% CL)	(D) ANCOVA *F*(2, 98) β (95% CL)	
Variable	Transgender men	Male		Transgender men vs. male	MMPI–2 scores Time 1
Scale 1: Hypochondria	−4.3 (9.8)	−0.4 (7.0)	**−3.90*** **[−7.24, −0.56]**	−1.31 [−4.50, 1.88]	**0.60***** **[0.44, 0.76]**
Scale 2: Depression	−4.8 (8.1)	0.7 (8.1)	**−5.45**** **[−8.66, −2.24]**	−2.30 [−5.65, 1.04]	**0.69***** **[0.54, 0.84]**
Scale 3: Hysteria	−4.5 (9.1)	0.1 (7.7)	**−4.61**** **[−7.93, −1.30]**	−2.67 [−5.71, 0.36]	**0.60***** **[0.44, 0.75]**
Scale 4: Psychopathic Deviate	−5.2 (8.6)	−1.7 (7.4)	**−3.51*** **[−6.66, −0.36]**	−1.26 [−4.11, 1.59]	**0.65***** **[0.53, 0.77]**
Scale 5: MF	−1.1 (7.0)	−0.5 (6.7)	−0.66 [−3.36, 2.05]	−0.02 [−3.00, 2.97]	**0.93***** **[0.80, 1.06]**
Scale 6: Paranoia	−6.0 (9.4)	0.1 (8.2)	**−6.05**** **[−9.54, −2.57]**	−2.14 [−5.24, 0.96]	**0.56***** **[0.43, 0.69]**
Scale 7: Psychasthenia	−3.9 (10.3)	2.0 (8.8)	**−5.88**** **[−9.65, −2.11]**	−2.19 [−5.58, 1.19]	**0.58***** **[0.44, 0.71]**
Scale 8: Schizophrenia	−4.0 (9.7)	1.3 (8.1)	**−5.26**** **[−8.78, −1.74]**	−1.58 [−5.03, 1.86]	**0.65***** **[0.52, 0.79]**
Scale 9: Hypomania	−0.1 (8.4)	0.7 (7.9)	−0.83 [−4.06, 2.41]	−1.53 [−4.61, 1.56]	**0.76***** **[0.63, 0.90]**
Scale 0: Social Inversion	−0.1 (5.9)	1.1 (6.7)	−1.03 [−3.53, 1.46]	0.34 [−2.26, 2.94]	**0.85***** **[0.75, 0.96]**

Note. Transgender men (n = 48), females (n = 62), and males (n = 53). Longitudinal linear models were fit to analyze the mean response profiles of respondents by transgender identity over time. The aim of this analysis was to characterize the patterns of change in the mean response over time and to determine if the shapes of the mean response profiles differ for transgender men compared with female and male controls. To test the null hypothesis that the mean response patterns of transgender men and female and male controls were parallel (i.e., no Group × Time interaction), we fit a Transgender Men × Time interaction term for each Minnesota Multiphasic Personality Inventory [2nd ed.; MMPI–2] scale score. [Null hypotheses: (A) Transgender men ΔT2 − T1 = Female ΔT2 − T1, and (B) Transgender Men ΔT2 − T1 = Male ΔT2 − T1]. ANCOVA: Linear regression models were fit with Time 2 scores as an outcome, and gender as a predictor, adjusting for Time 1 scores. Models were first fit with the referent group as female [Statistical model: (B) Time 2 MPPI–2 scale score = β0 + β1 (MMPI–2 Time 1 score) + β2(Transgender men) + e] and then with the referent group as male [Statistical model: (C) Time 2 MPPI–2 Scale Score = β0 + β1 (MMPI–2 Time 1 score) + β2(Transgender Men) + e]. Boldface indicates statistical significance. CL = confidence limits; MF = Masculinity/Femininity scale; e = error.
† $p < .10$. * $p < .05$. ** $p < .01$. *** $p < .0001$.

these high scores to be related to homosexuality in men (Martin & Finn, 2010). In the present study, elevated Masculinity–Femininity scores are thought to reflect gender dysphoria or discomfort with the female gender role as well as level of masculine interests (de Vries et al., 2011; Lothstein, 1984; Miach et al., 2000) and, consistent with previous literature using the female template (de Vries et al., 2011; Miach et al., 2000), indicate that transgender men were more likely to endorse stereotypical masculine interests than female controls. It is not surprising that transgender men still experienced discomfort with the female gender role and viewed themselves as more masculine after initiating testosterone. When scored according to the male template, although transgender men's mean Masculinity–Femininity score was within the normal range, it was found to be significantly higher than control males' at baseline and 3 months.

Although the Social Introversion scale was not clinically elevated for over 80% of the sample, transgender men were still found to function psychologically worse than male controls on this domain at both time points and worse than female controls at baseline only. As transgender men's average *T* score on this scale was closer to females' than males' at baseline (difference scores: 4.5 and 9.2, respectively), their scores did not have to decrease as much to become similar to female controls' scores. The Social Introversion scale measures self-consciousness, social avoidance, and self/other alienation. Transgender men's scores on these constructs are thought to be impacted by the

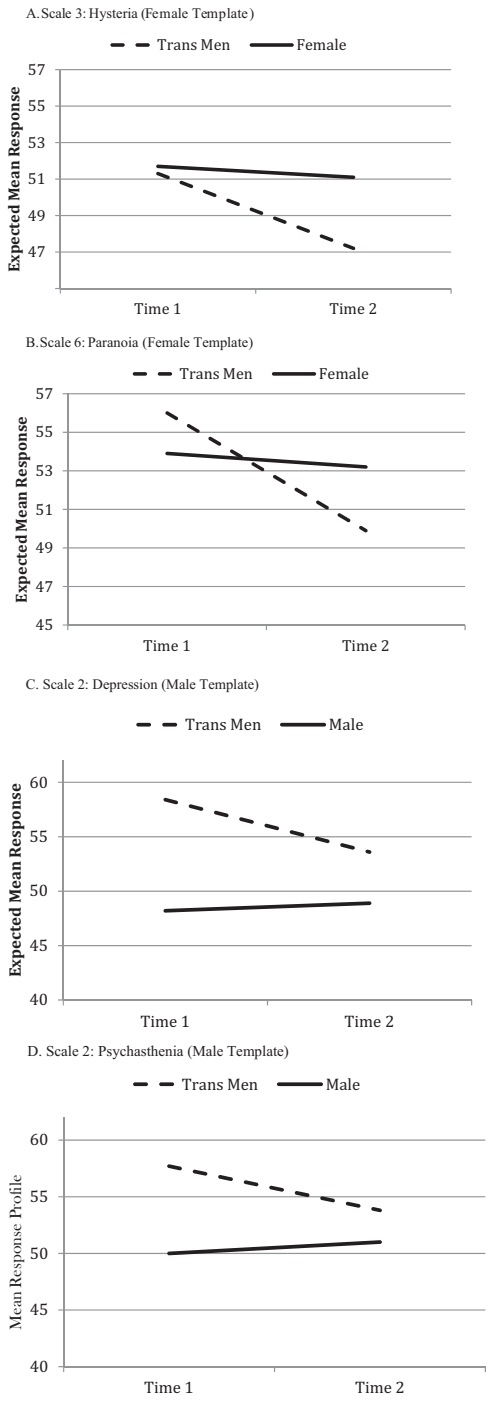

Figure 1. Graphical depiction of selected Transgender Man × Time interaction effects shown in Table 3. Panel A. Scale 3: Hysteria (female template). Panel B. Scale 6: Paranoia (female template). Panel C. Scale 2: Depression (male template). Panel D. Scale 2: Psychasthenia (male template). Trans = transgender.

social stigma of transgender identities. Prior to coming out, transgender men are typically expected by society to function in the female gender role. However, many pretransition and early transition transgender men feel uncomfortable in their body for many years prior to transitioning and often avoid social situations where they are not likely to be seen as males (Hendricks & Testa, 2012). Budge, Adelson, and Howard (2013) reported that while social support is important for the mental health and well-being of transgender people, there are "major deficits" in social support for this population. The minority stress theory (Bockting et al., 2013; Hendricks & Testa, 2012) posits that transgender men face high levels of social trauma and discrimination (Bradford, Reisner, Honnold, & Xavier, 2013; Clements-Nolle et al., 2006) and may be more likely to be hypervigilant or engage in isolation in order to protect themselves. Therefore, transgender men may be more likely to feel disconnected from others and lack a sense of belonging. As many transgender men's bodies are just beginning to masculinize at 3 months of testosterone treatment, they may not be perceived as men by others, and this may contribute to self-consciousness (Devor, 2004). It is thought that this scale may be sensitive to social stigma, trauma, and rejection and may not be measuring an introverted personality structure in transgender men. While transgender men's scores in this domain did not change compared with male controls, their scores were no longer significantly different from female controls at 3 months; however, a trend remained. This finding suggests that transgender men begin to become more comfortable in social situations, gain self-confidence, and become less sensitive to what others think of them after 3 months of testosterone treatment. These positive changes are likely influenced by environmental factors including a supportive transgender community, acceptance by family members and friends, and acceptance in social environments including school, work, and place of worship. Future research could elucidate these findings. Elevations on the Social Introversion scale may dissipate after further time on testosterone therapy. It remains a question if, as transgender men are more consistently witnessed socially as males (colloquially, "passing"), they report increased comfort in social situations (Gómez-Gil et al., 2012; Meier et al., 2011).

Second, transgender men functioned psychologically worse at baseline on multiple domains relative to female and male controls and demonstrated relatively higher rates of co-occurring problems. However, on average, transgender men's levels of psychological functioning were within the normative range. This finding is consistent with several previous studies of transgender people (Colizzi et al., 2014; Davis & Meier, 2014; Gómez-Gil et al., 2008; Hoshiai et al., 2010; Meier et al., 2011; Miach et al., 2000). Considering the societal oppression and high levels of discrimination this population faces, several findings showing that, on average, transgender men's psychological functioning is in the normative range, highlight the incredible resilience of this population and calls into question the pathologizing idea that a transgender identity is a mental illness. These findings further call into question policies that restrict the lives of transgender people on the basis of conflating transgender identity with mental illness or poorer psychological functioning.

One additional interesting pattern emerged from the data. Prior to beginning testosterone, transgender men did demonstrate lower psychological functioning when compared with an identity-matched gender group (i.e., healthy males). However, after initiating testosterone therapy MMPI–2 profiles of trans-

Table 4
Statistical Comparisons of MMPI–2 Clinical Elevations at Baseline (Time 1) and Acute Postbaseline 3-Month Follow-Up (Time 2) (N = 163)

	Female template						Male template					
	Transgender Men			Female			Transgender men			Male		
Variable	%	*n*	(A) Test statistic	%	*n*	(B) Test statistic	%	*n*	(C) Test statistic	%	*n*	(D) Test statistic
Any clinical elevation												
Time 1	77.1	37	**7.12****	54.8†	34	0.40	72.9	35	3.77†	41.5**	22	0.07
Time 2	54.2	26		51.6	32		58.3	28		43.4	23	
Two or more clinical elevations												
Time 1	43.8	21	**9.00****	35.5	22	0.89	45.8	22	**7.36****	18.9**	10	1.29
Time 2	25.0	12		37.1	23		27.1	13		13.2*	7	
Three or more clinical elevations												
Time 1	27.1	13	**5.44***	30.6	19	3.57†	33.3	16	**6.23***	5.7**	3	1.80
Time 2	12.5	6		22.6	14		14.6	7		11.3	6	

Note. Trangender men: $n = 48$; females: $n = 62$; males: $n = 53$. Pairwise comparisons were conducted using logistic regression models with each clinical elevation indicator as a binary outcome, and comparing transgender men with male and female controls, respectively. Minnesota Multiphasic Personality Inventory [2nd ed.; MMPI–2] Masculinity/Femininity scale (Scale 5) was excluded from summary count of clinical elevations. Boldface indicates statistical significance. Test statistic = McNemar's test statistic (1 degree of freedom) for matched pairs.
$^{\dagger}p < .10$. $^{*}p < .05$. $^{**}p < .01$.

gender men shifted in a healthier direction compared with both control groups, yet more so when using the identity-matched template (i.e., male template). Thus, in 3 months, transgender men's scores became more similar to controls who shared their gender identity. In fact, by 3 months on testosterone, transgender men's MMPI–2 profiles were no longer significantly different than male controls on the Psychastenia (anxiety) scale, and they were found to be functioning better than female controls in that domain and on Depression.

The baseline MMPI–2 profiles (based on the female MMPI–2 scoring template) of transgender men are consistent with previous cross-sectional research. For example, research has consistently reported that transgender men's average MMPI scale scores fall within the normative range prior to the initiation of testosterone (de Vries et al., 2011; Gómez-Gil et al., 2008; Rosen, 1974; Tsushima & Wedding, 1979). Prior research has also reported that before initiating testosterone therapy, transgender men demonstrate higher rates of co-occurring psychological problems (Hepp et al., 2005).

Because MMPI–2 interpretations have significant implications for the lives of transgender people (e.g., maintaining custody of their children, gaining employment, accessing medical treatments, and so forth), several considerations should be taken when interpreting transgender men's MMPI–2 scale scores, especially prior to transition or in the early weeks of initiating testosterone. First, the gender template chosen to score profiles as well as the stage of transitioning impacts the profiles of transgender men in that they are likely to appear psychologically worse at earlier stages of transitioning, especially if the male template is used. As the MMPI–2 was not normed for use with the transgender population, scores should be interpreted with caution. Because of the many significant changes in MMPI–2 profiles in a short period of time after hormone initiation, it is thought that MMPI–2 profiles should not be relied upon to evaluate readiness for hormone treatment in this population.

Scales of the MMPI–2 may be impacted by cultural variables unique to the transgender population. The Hypochondria and Hysteria scales may be influenced by feelings of gender dysphoria. The Psychopathic Deviate scale is believed to be elevated in transgender men due to interpersonal difficulties related to the lack of acceptance of transgender people in society (de Vries et al., 2011). Elevations on the Paranoia scale before initiating hormone treatment may be due to feeling misunderstood, mistreated, suspicious and guarded, lonely, resentful toward family members, and afraid of physical attack (Duckworth & Anderson, 1995). More recent research, however, supports the argument that the elevations on the Paranoia scale may in fact be an artifact of the high rates of discrimination and family rejection among transgender people (Bockting et al., 2013; Hendricks & Testa, 2012; Lombardi, Wilchins, Priesing, & Malouf, 2002) and thus may be realistic appraisals and not a true measure of paranoia. Finally, increased scores on the Schizophrenia scale may be reflective of transgender men's lived experiences including strained family relationships, social alienation, and questioning of one's self-worth and identity (Butcher et al., 2001).

This study also adds to the current body of research in that previous controlled studies of transgender individuals typically only compared transgender men with females; given that the transgender men typically report gender identities as males, this study offers a novel side-by-side comparison with both nontransgender females and nontransgender males. This allows a more nuanced summary of MMPI–2 profiles among transgender men. For example, at baseline, transgender men differed from both males and females on Social Introversion and Masculinity–Femininity, but they also differed from males on seven additional domains: Hypochondria, Depression, Hysteria, Psychopathic Deviate, Paranoia, Psychastenia, and Schizophrenia.

The most important finding in the current study was that 3 months of testosterone treatment improved psychological functioning in transgender men in multiple domains. This is important because MMPI–2 profiles are thought to remain stable over time even with intensive psychotherapy (Gordon, 2001; Spiro et al., 2000). Compared with control males in this study, scores for seven of the 10 scales—Hypochondria, Depression, Hysteria, Psycho-

pathic Deviate, Paranoia, Psychastenia, and Schizophrenia—significantly decreased in transgender men in 3 months, which is indicative of substantial improvements (Spiro et al., 2000); similar decreases were found for Hysteria, Paranoia, and Social Introversion when transgender men were compared with female controls. Moreover, the prospective decreases in depression and anxiety observed in the current study are consistent with prior cross-sectional studies of transgender men (Davis & Meier, 2014; Gómez-Gil et al., 2012; Meier et al., 2011). These testosterone-related improvements in psychological functioning have implications for the overall quality of life and physical health of transgender men.

There are several clinical implications of the MMPI–2 changes observed over 3 months of testosterone therapy with transgender men. First, because reductions in depression symptoms may correlate with reduced suicide risk in transgender men, withholding testosterone treatment on the basis of depression or suicidality may be iatrogenic (Levy, Crown, & Reid, 2003; Meier et al., 2011). Some clinicians believe that even if a person is certain that he or she is transgender, has some social support, is informed of the risks and benefits of cross-sex hormone treatment, is likely to adhere to treatment, and is able to make an informed decision, depression and suicidality must be decreased prior to initiating hormone treatment. Their practice may include withholding professional letters to support initiating hormone treatment and targeting interventions at depression and suicidality as a first step. However, this evidence suggests that hormone treatment directly decreases symptoms of depression. Therefore, it is suggested that clinicians consider providing a letter of support for hormone initiation at the same time as providing treatment options for depression and suicidality instead of denying access to hormone treatment on the basis of depression or suicidality alone. Second, improvements in the Hypochondria and Hysteria scales may indicate increases in health related to accessing medical care, increased comfort in social situations, and feelings of happiness (Duckworth & Anderson, 1995). Third, decreases in Psychopathic Deviate, Paranoia, Psychastenia, Schizophrenia, and Social Introversion may result from increased feelings of acceptance, decreased attempts to conceal transgender identity, increased passing in the self-identified gender (Bockting et al., 2013; Gómez-Gil et al., 2012); which may also consequently correlate with lower risk of discrimination and battery and less hypervigilance. It is also possible that the initiation of testosterone improves psychological functioning in and of itself, regardless of "passing." Fourth, although the Hypochondria scale does not typically change over time (Greene & Clopton, 1999), transgender men's improvements may be related to developing a more optimistic outlook on life and decreased gender dysphoria, which may occur when the secondary sex characteristics associated with testosterone use emerge. Fifth, increases on the Masculinity–Femininity scale based on the female template indicate that transgender men have further consolidated their male identity after beginning testosterone treatment.

There are several reasons that testosterone treatment might improve psychological functioning in transgender men. First, our results provide support to the idea that the act of initiating a gender transition may be the key factor in reducing psychopathology (Gómez-Gil et al., 2012). Second, beginning testosterone treatment is a form of validation of their gender identity by a professional and marks an important step for many transgender men in their gender transition. It is possible that this leads to improved psychological well-being (de Vries et al., 2011). Third, access to gender-affirming care for the first time sets transgender men on a path to living the gender with which they identify, and concealment or avoidance of their transgender identity is no longer occurring (Bockting et al., 2013). As Yalom (2005) stated,

> When we deny or stifle parts of ourselves, we pay a heavy price: we feel a deep, amorphous sense of restriction; we are constantly on guard; we are often troubled and puzzled by internal but seemingly alien impulses that demand expression. When we are able to reclaim these disavowed parts, we experience a wholeness and a sense of liberation. (pp. 92–93).

Results from this study point to the positive impact of testosterone treatment in transgender men on psychological functioning. Short-term psychotherapy is not typically associated with increased psychological functioning on the MMPI–2, much less several significant improvements, as were observed in this study following 3 months of testosterone treatment. Thus, although standard practice has been to treat psychological conditions in transgender men, including depression and anxiety, prior to considering any medical treatment for a gender transition (Hale, 2007), psychotherapy alone is not thought to be sufficient for clinical treatment of transgender men's psychological wellbeing.

Results from this study also have several implications for the interpretation of the MMPI–2 among transgender men. First, the MMPI–2 is currently used for assessing readiness for gender reassignment, personnel selection, and parental custody. Results indicate that transgender men's profiles improve once they begin testosterone treatment; thus, it is recommended that clinicians interpret MMPI–2 results with caution among pretestosterone transgender men and reassess the MMPI–2 after at least 3 months of testosterone therapy. Interpreting pretransition MMPI–2 results without taking transition status into account may inadvertently discriminate against transgender persons. Second, results from this study highlight that future research studies should consider using both male and female control groups and gendered scoring templates to test hypotheses concerning transgender men. Baseline profiles of transgender men initially showed significantly higher scores on nine scales when compared with males (all but Hypomania) than when compared with females (two scales: Masculinity–Femininity and Social Introversion); however, at the follow-up assessment, transgender men scored higher than males on four scales (Depression, Masculinity–Femininity, Schizophrenia, and Social Introversion) and did not score higher than females on any scale except the Masculinity–Femininity scale. In fact, by follow-up, females actually scored higher than transgender men on Depression and Psychastenia. Although transgender men's improvement in psychological functioning is clear relative to both male and female control groups, comparisons using gender identity-matched controls (i.e., males) demonstrate a much stronger effect.

This study is distinct from the few previous longitudinal studies with transgender samples for several reasons. First, these data are the first in the Western hemisphere to use both male and female control groups in a nonclinical, prospective research design. It is possible that transgender participants would have responded differently in clinical samples, when their testosterone treatment is contingent on their MMPI–2 profiles (Gómez-Gil et al., 2012). The

sample size in the current study is at least double compared with samples in previous longitudinal research with transgender men. This study also includes a wide age range of transgender men beginning testosterone.

This study has clinical implications that impact disciplines concerned with transgender health and well-being, including medicine, public health, and behavioral health. Some medical professionals hesitate or even avoid prescribing medications, especially controlled substances like testosterone, due to lack of training and research. Therefore, the results of this study may provide more information to providers who wish to (or need to) assess transition readiness or to otherwise meet the transition needs of their transgender patients.

Limitations

This study's generalizability is limited by the demographics of the nonprobability transgender sample, which in this study is primarily White and highly educated, not capturing the diversity inherent in the overall population of transgender men. In accordance with the Institute of Medicine (2011) recommendations on LGBTQ research, future research should include nonprobability samples that represent the diversity of transgender experiences and thus help create a more informed dialogue about the needs of the population overall. Next, transgender participants in this sample had access to medical care in the United States and had access to testosterone as part of their gender transition. The prevalence of psychopathology is yet unclear among transgender men who do not have access to or desire to initiate testosterone treatment. A limitation of our design is that one third of the sample had initiated testosterone therapy prior to baseline (e.g., potential bias); however, within-groups comparisons found no statically significant differences in baseline MMPI–2 psychopathology between transgender men on hormones ($M = 17$ days) and those who were not at baseline assessment. An additional limitation is that we did not measure therapy utilization over the course of the study; therefore, psychotherapy represents a potential confounder. It may be that hormone use and therapy have additive effects, and future research would benefit from examining the efficacy and effectiveness of combined bio-behavioral treatments (hormones and therapy). Additionally, levels of discrimination, acceptance, and hiding one's transgender identity were not measured. These variables may mediate the impact of hormonal transitioning on the psychological functioning of transgender men.

Future Directions

In the future, researchers who look at current psychological functioning of transgender samples should take transition status into account when interpreting current and past research reports, as the growing body of literature indicates that those who have started hormone treatment often report better psychological functioning (Gómez-Gil et al., 2012; Meier et al., 2011). Prior research that aggregates different transgender identified groups together (e.g., transgender men with transgender women or those who began medical treatment with those who have not) may have generated inaccurate conclusions on mental health status among transgender samples. Future researchers should examine if the same positive effects of feminizing hormone treatment are found in transgender women and if genderqueer individuals also demonstrate improvements in mental health related to cross sex hormone treatment. Longer term follow up studies are needed to determine if this positive effect is maintained over time. Consistent with the report of the Institute of Medicine (2011), we recommend that future studies include nonprobability samples representing the diversity of transgender experiences in order to create a more informed dialogue about the needs of the overall transgender population.

Conclusion

The current study is the first to demonstrate the direct positive impact of initiating testosterone treatment on the psychological functioning of transgender men. Overall, the results suggest that the majority of transgender men report subclinical levels of psychological distress before initiating testosterone treatment. Also, although they initially demonstrated poorer psychological functioning than nontransgender males, transgender men, by their third month on testosterone, were functioning as well as male and female controls and demonstrated positive gains in multiple clinical domains. The MMPI–2 profiles of transgender men who completed 3 months of testosterone treatment demonstrated significantly more psychological improvements than what is typically reported in the same time frame with psychotherapy alone. Overall findings here suggest significant, rapid, and positive effects of initiating testosterone treatment on the psychological functioning in transgender men.

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